PORTABLE AIR CONDITIONER AND LIQUID CONTAINER

Field of the Invention

[001] The present invention relates generally to portable air conditioning units that cool the surrounding air by ingesting the surrounding air and cooling it by fanning the air across a surface area that is in direct contact with liquid that is much cooler than the surrounding air so that the surface area temperature approaches that of the liquid. The unit also functions as a liquid storage container that may be used to store drinking water or other consumable beverages.

Background of the Invention

[002] Air conditioning units are very expensive, bulky, contain elements that are potentially harmful to the environment, and often require an AC external power source to operate. On warm days when it is difficult for an individual to maintain comfort due to the heat, it is often desirable to remain in an air-conditioned environment. This is very difficult to do when shelter is unavailable and the individual is directly exposed to the elements for an extended period of time, such as when working outdoors or attending an outdoor sporting event. Even in sheltered environments, there are many occasions when it is desirable to cool the surrounding environment as rapidly as possible such as when entering an automobile that has been exposed to the sun for a long period of time.

[003] The present invention makes use of a portable apparatus that includes a reservoir for cooled liquid or ice. The reservoir is insulated with the exception of its

bottom surface, which doubles not only as the bottom area of the reservoir, but also as the top to a heat sink that provides the area below the reservoir which acts as an air duct. The heat exchange system is substantially hollow but may also contain a series of fins that are in contact with the reservoir. The heat exchange system is designed to maximize the exposure of the air to the exposed surface area of the reservoir since the only air that is cooled is the air that directly comes in contact with the exposed surface of the reservoir. Generally, the heat exchange system should be located on the bottom of the unit so the heat transfer between the outside air and the bottom surface area of the reservoir may occur even when there are very low levels of cooled liquid in the reservoir. This would take advantage of the principle that the coldest liquid will always remain at the bottom of the container while in a given environment thus making an even more efficient cooling system.

[004] When the reservoir is filled with cold liquid or ice, the exposed surface area of the reservoir becomes cooled to the temperature of the reservoir's contents. The heat exchange system is connected on one side by an air intake chamber and by an air exhaust chamber on the other. Warm air is drawn into the intake chamber from a battery-powered variable-speed motorized fan that creates a vacuum. The fan then pushes the warm air through the heat exchange system and is dehumidified and cooled by coming into direct contact with the exposed surface area of the reservoir and fins that extrude perpendicularly from the bottom surface of the reservoir within the heat exchange system. The fins provide resistance and vary the direction of the air, creating turbulence. Also, coolness from the exposed surface area is transferred down through the fins providing additional cooled surface area, which contacts and

further cools the air. The turbulence greatly enhances the thermal conductive capacity of the system so that the heat transfer can occur at a highly efficient rate and maximizes the time that the temperature of the exposed surface of the reservoir remains cold. The cooled air is then propelled into the exhaust chamber where it is thrust into the external environment and may be directed at an individual or used to generally cool a surrounding area.

[005] Over a period of time while cold fluid comes in contact with the surface of the heat exchanger that is exposed to the interior of the reservoir or container, a narrow region next to the surface of the heat exchanger exists where the velocity of the fluid is zero and rapidly changes to a finite number as the distance from the surface increases. This is known as the boundary layer. The fluid's velocity is zero due to a variety of factors ranging from molecular attraction to surface tension to friction. When a boundary layer forms, it may prevent the surface area of the fins from efficient thermal conductivity between the inner reservoir to the surface area of the fins. This lack of conduction is due to the layer of insulation the boundary layer creates from the fluid directly adjacent to the exposed surface of the heat exchanger.

[006] The reservoir may also include additional features such as a pour spout so that the liquid inside the reservoir may be consumed. The reservoir may also be removed from the unit so that its contents may be stored in a refrigerated environment. This allows multiple reservoirs to be used in succession thereby increasing the amount of time that cool air may be generated. Another feature of the apparatus is that the airflow may be directed by means of an extendable hose, which is embedded within the exhaust chamber of the unit. The entire external surface of

the unit should be heavily insulated in order to prevent unwanted heat from coming into contact with the reservoir's contents.

DISCUSSION OF THE PRIOR ART

[007] The use of air conditioners is known in the prior art. More specifically, air conditioners that cool the surrounding air that exchange heat while passing outside air over cooled surfaces is discussed in the prior art. Other similar portable air conditioning devices are disclosed in U.S. Patent Nos. 6,427,746; 6,227,004; 6,119,477; 5,953,933; 5,062,281; 5,046,329; and 4,841,742.

[008] While these devices aim to function as air conditioners, and while each invention disclosed in the respective patents may disclose a feature of the present invention, none of the above-listed patents disclose the combination of features in the present invention either individually or in combination with each other in such a way that it would have been obvious to do so at the time the present invention was conceived.

[009] In addition, there is a need in the art for a device which can function as both a portable air conditioner and a beverage container that maximizes the time that ambient air may be cooled within the small confines of a portable unit to a temperature much lower than the ambient air temperature and accomplishes these tasks utilizing a removable cooling source in combination with a directed application of the cooled air. A device of this type is disclosed by the present invention.

SUMMARY OF THE INVENTION

[010] Broadly, it is an object of the present invention to provide a portable air conditioner that includes a separate container for storing cool materials such as cold water or ice or containers of items to be cooled, which may also be consumed by the user.

[011] It is a further object of the present invention for the container to be composed of a thermally conductive material for storing cold liquid or ice and that such cold liquid can be safely consumed.

[012] It is a further object of the present invention to provide a portable air conditioner that utilizes a motorized fan to ingest outside air and cool it by passing the air over a substantial portion of the thermally-conductive, non-toxic material before propelling the cooled-air back into the environment.

[013] It is a further object of the present invention to minimize the temperature of the cooled air by passing the air through a turbulent environment.

[014] It is a further object of the present invention to locate the thermally-conductive material on the bottom of the container.

[015] It is a further object of the present invention to maximize the efficiency of heat exchange by minimizing the effects of the formation of a boundary layer on the thermally-conductive material.

[016] It is a further object of the present invention to provide a removable container that may be removed from a base unit and easily and thoroughly sanitized.

[017] It is a further object of the present invention to provide an adjustable and expandable hose that may be used to direct the flow of cooled air where desired.

[018] It is a further object of the present invention to provide a pour spout that enables the contents of the container to be conveniently consumed.

[019] It is a further object of the present invention to provide a method of cooling outside air that efficiently ingests outside air, and cools it by passing the outside air in a turbulent manner over and through a cooled surface area of a container and expelling the cooled air into the environment.

[020] The description of the invention which follows, together with the accompanying drawings should not be construed as limiting the invention to the example shown and described, because those skilled in the art to which this invention appertains will be able to devise other forms thereof within the ambit of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[021] **FIG. 1** is a perspective view of the apparatus;

[022] **FIG. 2** is a perspective view of an apparatus showing the removable container separate from the base of the apparatus;

[023] **FIG. 3** is a front view in cross section of the apparatus demonstrating the direction of air intake, flow and expulsion from the apparatus;

[024] **FIG. 3A** is a side view in cross section of the removable reservoir;

[025] **FIG 3B** is a front cross-sectional view of the reservoir with the thermally-conductive surface area extending inside of the reservoir.

[026] **FIG 3C** is a front cross-sectional view of the reservoir with a drainage tube for removing excess liquid from the inside of the reservoir.

[027] **FIG 3D** is a front cross-sectional view of the reservoir with an agitator for mixing the contents inside of the reservoir.

[028] **FIG. 4** is a front view in cross section of the apparatus with the expandable hose fully extended;

[029] **FIG. 5** is a detailed view of the expandable hose fully retracted;

[030] **FIG. 6** is a detailed view of the expandable hose fully extended.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[031] By way of one example of many to serve as background in understanding the present invention, **Fig. 1** shows a portable air conditioner **100** that includes a base unit **110** and a removable beverage container **120**. The container **120** is intended for storing a liquid or solid whose temperature is substantially colder than the air temperature outside of the air conditioner **100**. A spout **130** provides access to the contents of the container **120** which may include a chilled beverage such as ice water. A handle **125** is included for easy portability. The container **120** is secured within the base unit **110** as shown in **Fig. 1**. The external portion of the base unit **110** includes an air intake valve **140** that takes in air from outside of the air conditioner **100** for processing within the unit **110** and is expelled out an air nozzle **155**. The air nozzle **155** is connected to an expandable hose **150** such that expelled air from the nozzle **155** can be directed to a given location.

[032] In **Fig. 2**, the container **120** is shown removed from the base unit **100** with its handle **125** fully extended. The container **120** is comprised of a combination of highly thermal-conductive, non-toxic material such as aluminum that forms the bottom of the container **160** and a non-toxic material such as plastic that forms the

sides of the structure **165**. The lower portion **160** is exposed and comes into direct contact with the base unit **110** when secured. It is a primary goal for the lower portion **160** to obtain, and subsequently retain, the same temperature of the liquid or solid inside of the container **120** for as long as possible, and to remain in constant contact with the surface area **175** thereby cooling the surface area **175** to the temperature of the liquid **200** inside the reservoir **220**. The surface area **175** of the lower portion **160** is used to cool any air that comes into contact with the surface area **175**. Because the container **120** is removable, it is possible to fill the container **120** with a given liquid and store it in a refrigerated environment for use at a later time. The container **120** may also be filled with liquid and stored in a freezer so that the entire contents of the container 120 becomes frozen. A typical size of the container **120** can hold between one half and two gallons of liquid.

[033] **Fig. 3** shows the cross-sectional view of the air conditioner **100** with the container **120** secured within the base unit **110**. As shown, a cooled liquid **200** is filled approximately ¾ to the top of a reservoir **220**. The container **120** is surrounded on all sides by insulation **210** in order to maximize the time that the cooled liquid **200** retains its original temperature.

[034] Air from outside of the air conditioner **100** is drawn into the air intake chamber **140** by means of a high-speed electric motor **255** that may be powered by a battery **260**. An alternative embodiment of the invention may include an AC/DC power source. However, an AC/DC power source is understood to limit the portability of the air conditioner **100**. The motor **255** turns a rotating fan **250** in a manner that creates an airflow **230** that pulls in warmer air from outside of the air conditioner **100**.

It is desirable to minimize the volume of the air intake chamber **140** while maximizing the amount of airflow **230**. The airflow **230** follows the general direction as shown with the arrows through from the air intake chamber **140** through the fan **250** and into the central chamber **240**. It is desirable to maximize the volume of the chamber **240** while creating turbulence in the air through the use of fins **245 (Fig. 3A)**. The fins **245** would be in direct contact with the lower surface area **175** and would create an environment such that the air molecules would maximize the time that they come in contact with the conductive surface area **175** thereby allowing the temperature of the airflow **230** to be minimized so that it may approach the temperature of the liquid **200** inside of the reservoir **220**. Because the chamber **240** is in direct contact with the lower portion **160 (Fig. 3A)** of the container **120**, the lower portion **160** is able to continually cool the surface area **175** for as long as there is even a minimal amount of liquid **200** remaining in the reservoir **220**.

[035] As shown in **Fig. 3A**, one embodiment of the removable container **120** demonstrates how the cooled surface area **160** may be arranged to maximize the length of time that the airflow **230** may come in direct contact with the cooled surface area **160**. As can readily be seen, the lower surface area **175** of the reservoir **220** is configured with a series of vertically arranged fins **245** that protrude perpendicular to the lower surface **175**. The fins **245** are comprised of an efficient thermally-conductive material such as aluminum or copper. It is understood that the fins **245** are not required to be positioned exactly perpendicular to the lower surface **175**. As stated above, because the fins **245** are directly connected to the lower surface **175** of the reservoir **220**, the temperature of the surface areas of all fins **245** will drop to

the temperature of the lower surface **175** which would be the temperature of the contents **200** of the reservoir **220**. As the airflow **230** passes between the fins **245**, the airflow **230** will have a maximum amount of cooled surface area in which it will come in contact thereby minimizing the temperature of the airflow **230**. The airflow **230** will also bounce back and forth between each of the fins **245** thereby creating air turbulence **240** as shown in **Fig. 3**. In an alternative embodiment, the fins **245** can be arranged in a maze-like formation such that the airflow **230** would reverse its direction of travel several times thus creating more turbulence and still enabling the airflow **230** to maximize the surface area of the fins **245** that it contacts.

[036] Alternatively, in **Fig. 3B** the fins **245** may form one continuous thermally conductive surface with internal fins **246** that extend within the reservoir **220**. The increased surface area of the fins increases the thermal conductivity activity of the entire content of the container and reduces the thermal conductive resistance presented by the boundary layer. With the addition of the fins **246** that are directly connected to the fins **245** it was noticed that a substantial reduction, and in many cases, a complete elimination of the thermal conductive resistance would occur. As a result, a more efficient heat transfer may occur thereby maintaining the coldest possible temperature on the surface area of the fins **245** for the longest possible time.

[037] In an alternative embodiment that also serves to address the problem of boundary layer formation, **Fig. 3C** offers an alternative approach when the contents of the reservoir are intended to be completely frozen. A drainage pipe **222** is included at the lower surface **175**. The pipe **222** has an opening **224** that extends

within the reservoir **220** and a cap **223** on the external end of the pipe **222**. When this embodiment is used with a reservoir **220** that contains frozen contents, the pipe **222** is used to drain excess liquid that may melt from the frozen contents over time. Through experimentation, it was learned that as the frozen material in the container **220** melted and the liquid formed was ample enough, an insulating boundary layer would form on the lower surface area **160**. However, when excess water was drained away from the reservoir **220** and specifically the area of thermal conductivity or the lower surface area **160**, the boundary layer would be less likely to form on the lower surface area **160**, and many times would not form at all.

[038] In another embodiment as shown in **Fig. 3D**, an agitator **251** is included within the reservoir **220**. The agitator includes a set of blades **252** that are fixed perpendicular to a rod **253** such that when the rod **253** is rotated in a circular fashion, the blades **252** will mix the contents of the reservoir **220**. This may be necessary when some of the contents of the reservoir **220** become stagnant and the fluid is allowed to form a boundary layer on the lower surface area **160**. By mixing the contents of the reservoir **220**, it will allow for the lower surface area **175** to maintain the temperature of the contents of the reservoir **220** for the longest period of time. It is understood that the agitator **251** may operate either manually by means of an external crank, or electrically by means of a motor. The agitation could also be created by the introduction of a pump that introduces outside air **100** or the recycled contents of the container **220** into the stagnant contents of the container **220** to disrupt the plaid nature of the fluid and the boundary layer. This embodiment may also be combined with the embodiments in **Figures 3B or 3C**.

[039] Referring back to **Fig. 3**, upon exiting the chamber **240**, the airflow is now cooled substantially below the ambient air temperature and proceeds toward the exhaust chamber **290**. In the preferred embodiment, the airflow **230** travels through an expandable hose **280** that may be extended like an accordion **300** as shown in **Fig. 4** to direct the airflow **230** in whatever direction and point desired by an individual.

[040] **Figs. 5 and 6** show more detailed drawings of the expandable hose **280** that is connected to the exhaust valve **290**. The hose **280** is attached on one end to a catch **270** and on the other end by the exhaust valve **290**. As shown in **Fig. 5** with the hose **280** in its fully retracted position, the combination of these three elements sits within an insulated exhaust guide **310** such that when the hose **280** is extended fully as shown in **Fig. 6**, the catch **270** may move upward within the guide **310** until it reaches the top of the guide **310** thus allowing the valve **290** to be directed to whatever location the user desires.

[041] While the inventive apparatus, as well as a method of cooling ambient air as described and claimed herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiment of the invention and that no limitations are intended to the detail of construction or design herein shown other than as defined in the appended claims.

[042] Although the invention has been described in detail with reference to one or more particular preferred embodiments, persons possessing ordinary skill in the art to which this invention pertains will appreciate that various modifications and

enhancements may be made without departing from the spirit and scope of the claims that follow.